# Public Health: Infectious disease surveillance systems

**Date: 6/14/2002**

**Primary Partners:**

CDC · NIH · EPA · USGS · NOAA · DoD

Socioeconomic Impact

Data standards, compression algorithms, transmission protocols support sustained integration of geospatial and public health surveillance system data

**Automated disease-specific surveillance enhanced with operational measurements and proven algorithms using weather/climate/environment predictive capacity**

**Public health surveillance systems able to track weather-climate-environmental factors to predict disease outbreaks**

High speed computation and technologies developed for integration, analysis, and visualization of weather/climate/ environmental data, correlation with adverse public health events.

**Weather/climate/environment algorithms supporting disease prediction models are verified, validated, and benchmarked.**

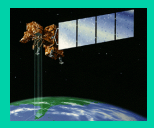
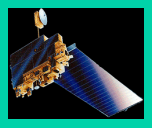
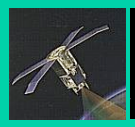
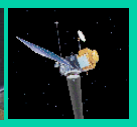
Remote sensors yield information on: vegetation/crop type, vegetation green-up, ecotones, deforestation, forest patches, flooded forests, general flooding, permanent water, wetlands, soil moisture, canals, human settlements, urban features, ocean color, sea surface temperature, sea surface height.

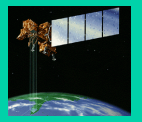
**Weather/climate/environment-disease relationships discovered, verified, validated and benchmarked for assimilation into operational models (I.e. RSVP)**

***This roadmap depicts improvements in surveillance of disease potential coupling environment/disease relationships with development of predictive models. More rapid improvements will occur with integration of geospatial data into existing surveillance systems.***

**Current disease surveillance approaches lack complete information on weather/climate/environmental factors.**

**Enhanced public health surveillance systems**
**-- Weather/climate/environment factors accounted for in disease models.**
**-- More accurate and precise disease predictions: warning time increased proportionally**

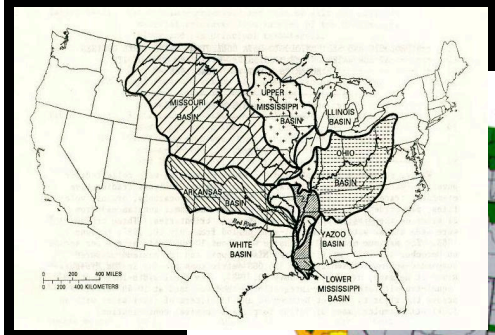



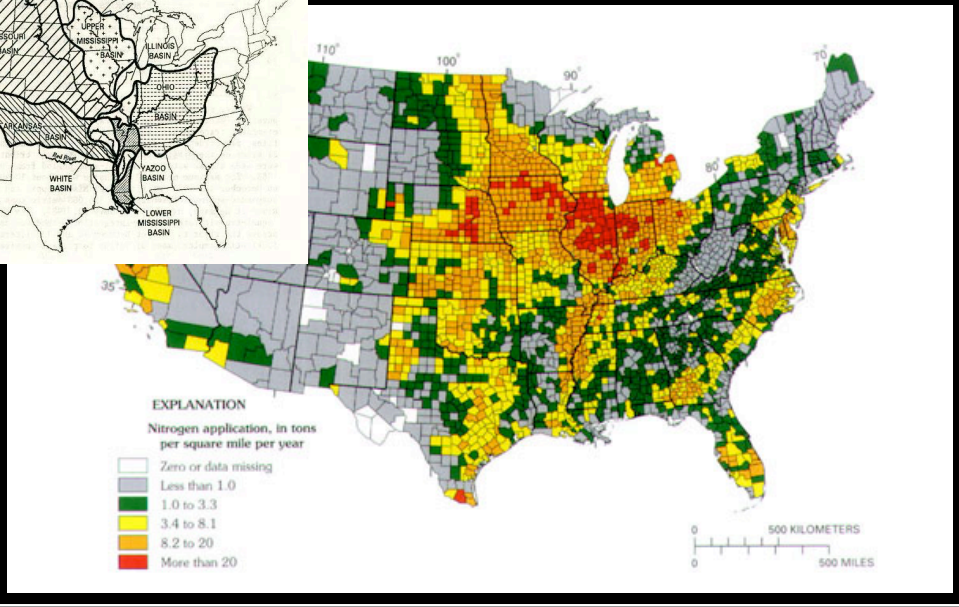

Landsat
Aqua
Terra
SeaWiFS
TOPEX
NOAA-POES
LDCM
NPOESS

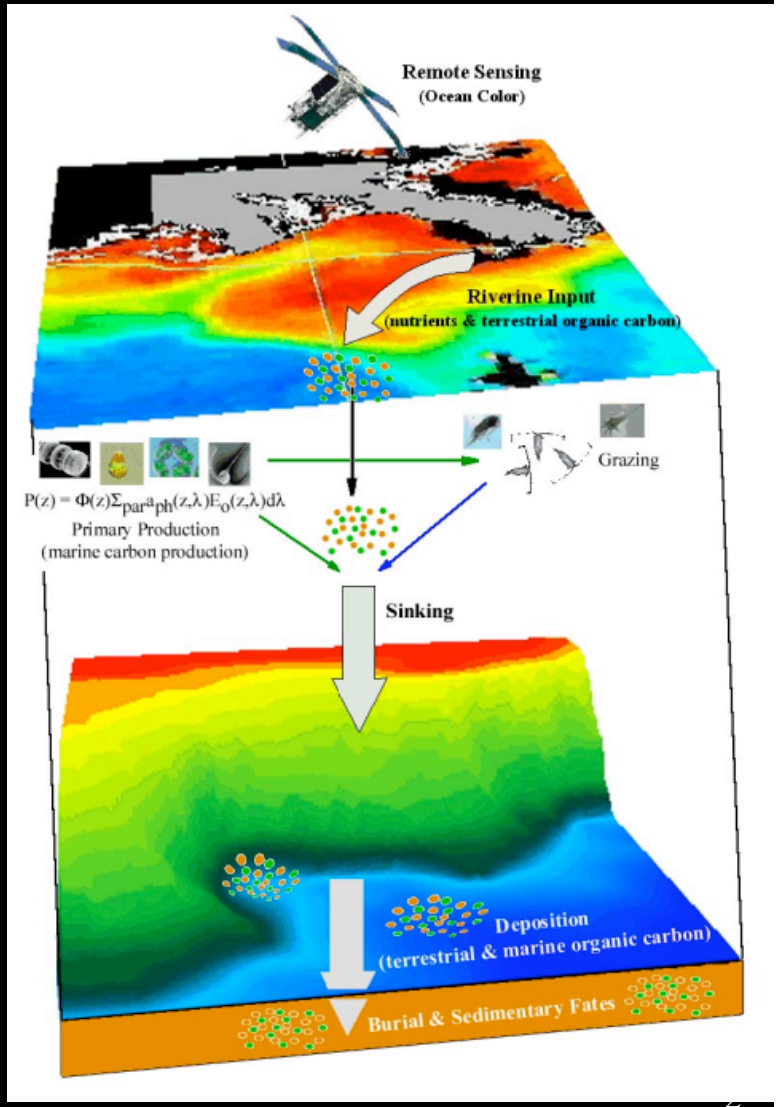
2000 2002 2004 2006 2008 2010 2012

# Water Quality: Hypoxia Assessments

- Hypoxic waters (< 2 mg $l^{-1}$ $O_2$)
- Global problem; largest area in US is found in the northern Gulf of Mexico (16,000 to 20,000 $km^2$ in '93 to '00)
- Major cause – nutrient enrichment leading to algal blooms




# *Water Management and Conservation:*

## *Assessments and forecasts of water supplies*

**Date: 6/14/2002**

**Primary Partners:**

USGS science for a changing world

Bureau of Reclamation — Managing Water In The American

USDA

EPA

Socioeconomic Impact

AWARDs (c. 2012) — USGS science for a changing world

Three forecasts of precipitations and daily crop water use towards reduction of real-irrigation. Seasonal forecasts for optimum vegetation selection and improved water use efficiency

Second generation data from missions and prediction and assessment models

**Improved capability in DSS resulting from the data, predictions, information products and new science knowledge**

Incorporation of NASA's SPoRT project's short-term weather forecasts

**Improved capability of DSS to modify advice based on short term predictions (<12 hours) of nominal and severe weather events.**

Seasonal Forecasts from NASA's Seasonal to Interannual Project (NSIPP)

**Improved water supply and water use potential for a given area for the DSS to result in improved crop selection .**

GRACE & AMSR, combined with GLDAS & LIS projects

**Improved assessments of surface and sub-surface water storage and transport.**

Deployment of Land Data Assimilation Systems (LDAS) and Vegetation Data Sets (from MODIS)

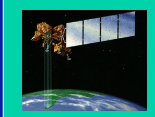
**Additional information on current precipitation and potential crop water use statistics. Better knowledge of current crop existence (higher accuracy)**

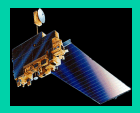
USGS science for a changing world

AWARDS (c. 2002)

Agricultural Water Resources and Decision Support, limited to real-time rainfall and daily crop water use estimates

***Current trajectory:***
***Steady improvement in water quality and quantity assessments***

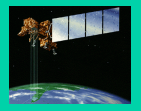

Landsat 7

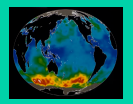

Terra


Aqua


GRACE


**VCL


LDCM


*GPM

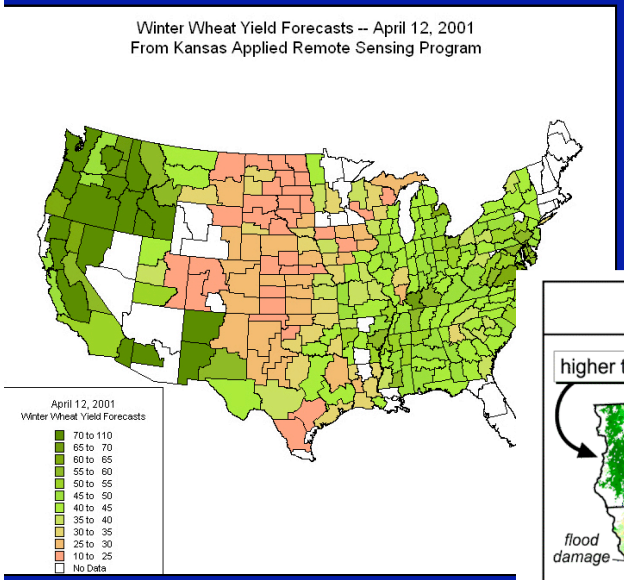

NPOESS

*In formulation
**In review

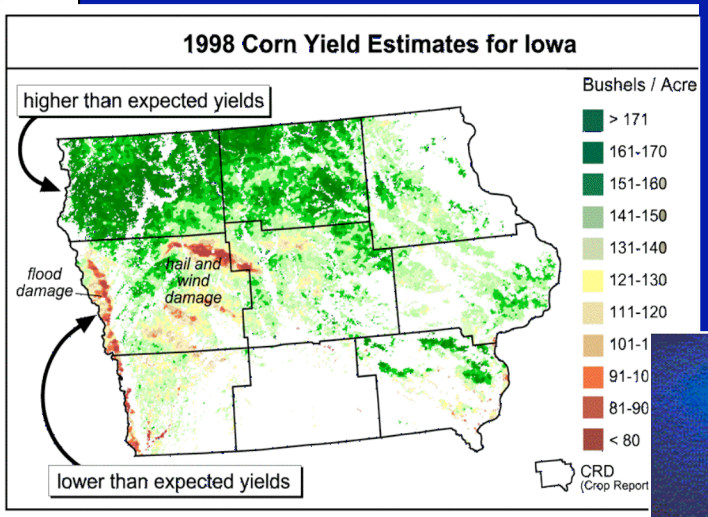
2000 2002 2004 2006 2008 2010 2012

**An integrated decision support system assimilating models and measurements of water transport and storage.**

# Agriculture: Improving Efficiency

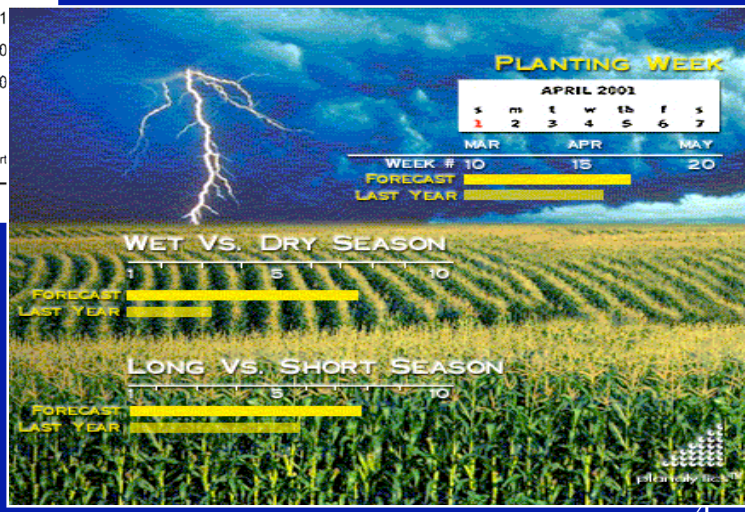



**An applications research project with the University of Kansas has led to it's spinning off a new business in crop yield forecasting**




ag20/20

**A partnership with USDA and four growers associations representing 100,000 US farmers is demonstrating new techniques for precision agriculture**





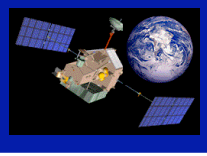

# ESE for Agricultural Competitiveness

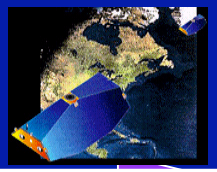
Date: 6/14/2002

NASA → NOAA

Research → Operations

| | 2002-2003 | 2004-2005 | 2006-2007 | 2008-2010 |
|---|---|---|---|---|
| SCIENCE | Snow and Soil Moisture Sensing Validation Experiments | Data Assimilation Of Multi-Satellite Observations | Weather Forecasting Modeling & Climate Prediction Modeling | Meteorology |
| MISSIONS | TRMM – Tropical Rainfall Measuring Mission | QuikSCAT | Aqua; GRACE – Gravity Recovery and Climate Experiment | Global Precipitation Measurement (GPM) * |



* In formulation

Applications Research → Validation & Verification → Applications Demonstration

APPLICATIONS

USDA Competitive Agriculture Program

Soil Moisture Products | Precipitation Forecasts | Seasonal Predictions | New Services & Technologies

FAS Forecast DSS



# Homeland Security: OHS Situation Center Preparation, Warning & Response

**Date: 6/14/2002**

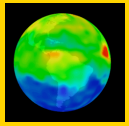
**OHS Situation Center (c. 2012):**
- Prepared with integrated data streams
- Information for warnings & alerts
- Rapid data to support responders and officials with info & analysis

**Primary Partners:**

USGS science for a changing world

Socioeconomic Impact

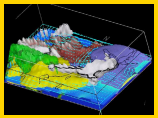
- Day/night air monitoring
- Trace gas measurements
- Improved circulation models



**Outcomes:** Streamline tasking for priority threats and flow of information. Reduce

**Impacts:** major illnesses and deaths from events.

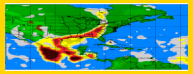
- Long-range deposition
- Bio-optical detection sensors and buoys
- Plume transport visualizations



**Outcomes:** Rapid identification of air/water biological agents. Trace sources & destinations Issue health alerts.

**Impacts:** Manage public reaction, fear, and over-reaction.

- Plume chemistry and speciation
- Robust satellite data assimilation
- Aerosol & trace gas characteristics



**Outcomes:** Improved information for first responders and recovery efforts. Warnings to food handlers & water treatment plants.

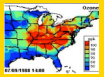
**Impacts:** Reduce exposure to first responders. Minimize extent of economic impacts.

- Plume advection/deposition
- UAV monitoring and rapid response communications links
- Visualization techniques

**Outcomes:** Identify downstream exposure to airborne/waterborne contaminants. Increase warning time to people/officials .

**Impacts:** Reduce health effects and exposure to livestock. Reduce hospital admissions and lost productivity.

- Simulation planning
- Database of sensors
- Sensor validations/verifications



**Outcomes:** Scenario coordination and planning for organized response. Appropriate sensors to match threat.

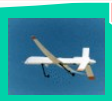
**Impacts:** Minimize subsequent exposure to populations and secondary effects.

***Current trajectory: Improvements in plume modeling, sensor capabilities, and visualizations.***

**OHS Situation Center (c. 2002):**

**Early formation stage.**


QuikSCAT


UAVs


Aqua


GRACE


AERONET


Aura


CloudSat


MOBY


GIFTS


NPOESS

* Pre-formulation

2000 2002 2004 2006 2008 2010 2012

Improved capabilities to homeland security officials to prepare, warn, and respond to homeland threats, especially air and water exposure.

# Socioeconomic Benefits

| National Applications | Estimated Economic Benefits | Citation |
|---|---|---|
| **Energy Forecasting** | **$9.58 B / yr**<br><br>Estimated annual benefit from implementation of the POWER Project (Biomass Energy Industry and Energy Resource Planning Phases only; average for 2002-2017) | LARC Report: *An Estimate of NASA/ESE/POWER Program Benefits to the U.S. From 2002 through 2017*, June 3, 2002. |
| **Carbon Management** | **$150B / yr**<br><br>Cost savings by soil sequestration for meeting the WRE Carbon 550 Emissions constraint as determined by the MiniCAM model | *Carbon Sequestration in Soils: Science, Monitoring and Beyond*; St. Michaels Workshop, Dec 1998 |
| **Agricultural Competitiveness** | **$300M / yr**<br><br>Projected annual benefit from improved crop prediction based upon better climate forecasting | *NOAA Strategic Plan*: *A Vision for 2005*; September 1998 |



# Socioeconomic Benefits

| | | |
|---|---|---|
| **Air Quality Management** | **350,000 fewer cases of aggravated asthma & 5,000 premature deaths**<br><br>**1 million fewer cases of reduced lung function in children**<br><br>**$500 million estimated from ozone reductions…EPA estimate of annual benefit from adopting new NAAQS standards** | EPA Fact Sheet, June 25, 1997<br><br>EPA Fact Sheet, July 17, 1997<br><br>US EPA, National Air Quality and Emissions Trends Report, March 2001 |
| **Disaster Management** | **$240M / yr**<br><br>Reduction in losses/yr to the Property and Claims industry through adoption of geospatial technologies estimate $100M per typical hurricane if 24 hour evacuation predictions could be improved to 300 miles of coastline | Insurance Services Office (ISO), 2002.<br><br>*Weather Impacts, Forecasts and Policy,* March 2002 BAMS |
| **Public Health** | **$200M / yr**<br><br>Amount that could be reduced to contribute to managing risks for asthma. | Johns Hopkins School of Public Health, May 2000 |



# Socioeconomic Benefits

| | | |
|---|---|---|
| Coastal Management | Reduce economic impacts from harmful algal blooms (HABs) affecting 1) public health 2) commercial fishery 3) recreation and tourism 4) monitoring and management costs | WHOA Technical Report 1999 |
| Invasive Species | **$140 to $408M / yr**<br><br>Estimated aggregated benefit of reduced environmental damage, reduced crop yield losses and decreased use of herbicides | Office of Technology Assessment (OTA). Report OTA-F-565, 1993. |
| Water Conservation and Management | **$11B / yr**<br><br>Approximation of partial benefits of current water quality levels as compared to what they would have been w/o water pollution control programs | Application Profile (U.S. EPA) |



# Socioeconomic Benefits

| | | |
|---|---|---|
| **Aviation Safety** | **$1.66 B / yr**<br><br>Average annual savings combined from using synthetic vision system (SVS) to improve airport capacity and delay efficiencies at 10 U.S. airports | NASA Langley Research Center, July 2000 |
| **Community Growth** | **>$1M / yr for one city**<br><br>More efficient decision making for planning offices saved one city planning office (Scottsdale, AZ) millions of dollars/yr | GIS World November 1997 |

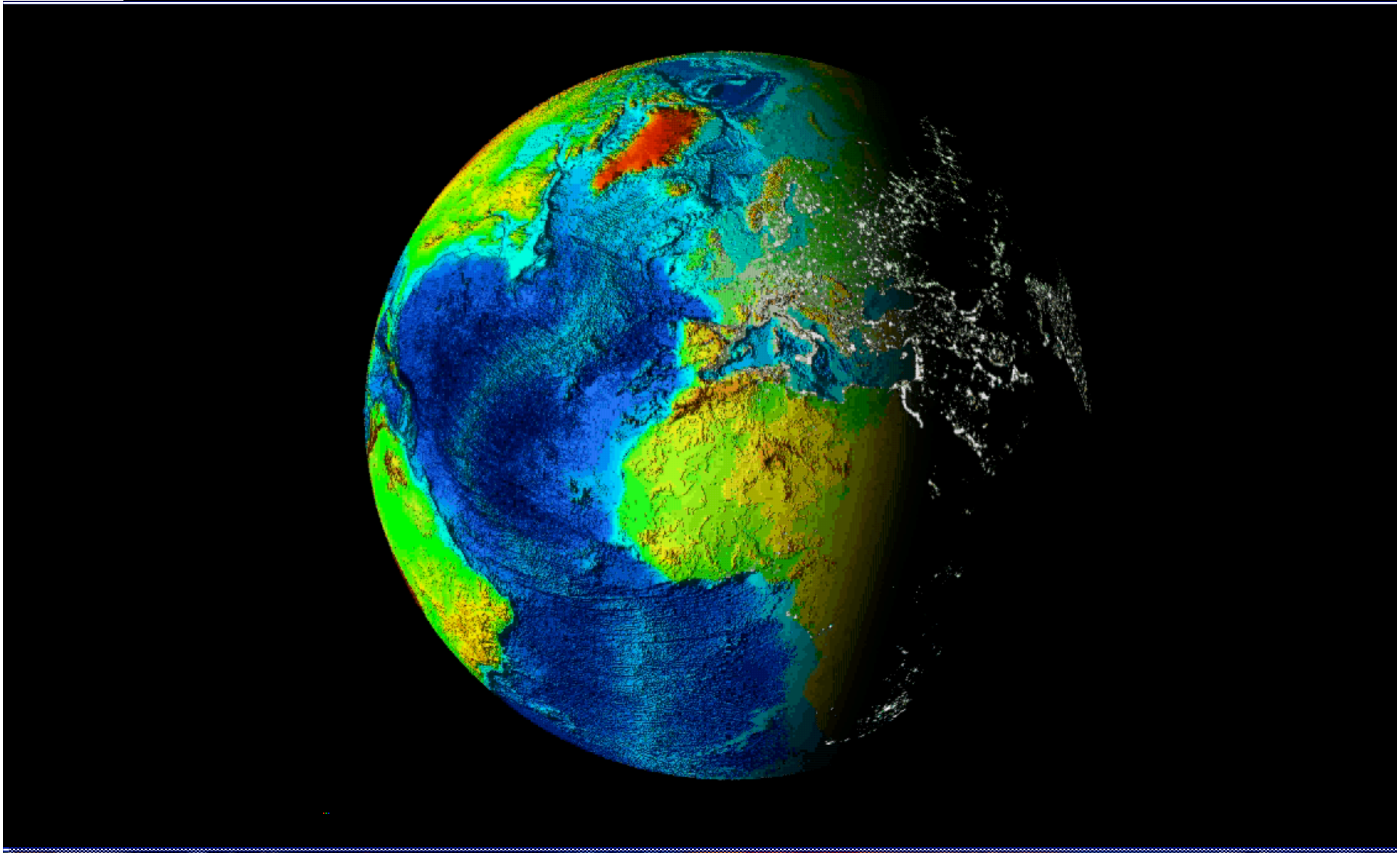


# Community Benefits

- USGCRP/CCRI
  - Human Dimensions Working Group
- NRC Committee Briefings
  - BESR, BASC, CONNTRO, Geography, Beyond Mapping
- Research to Operations Community
  - USWRP, AMS
  - USDA, NOAA, USGS, FEMA, EPA, CDC, OHS, DOT, DOE
- Outreach
  - EOM special issue on Earth Science
  - Dedicated issue on Earth Science Models
  - RSE Issue on Federal Government Data Buys



# Education



# Education Program Progress

- Education Strategy
  - Purpose, Approach, Expectations
  - Driving Forces
- GLOBE
  - Transfer from NOAA to NASA
  - Cooperative Agreement Notice
  - 100 International Partners
- Virtual Earth:  A World of Science and Solutions
- DEVELOP



# Driving Forces

- Agency vision and mission
  - "inspire…"
  - "…as only NASA can"
- Code N focus
  - K-12, Mission Specialist, Telepresence
- Findings of Revolution Workshop for Earth Science
- Success with product developments
- Success with Grants
- Limited adoption in classrooms on national scale



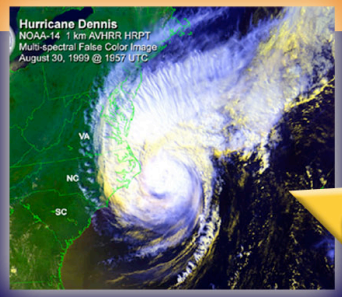
# Enriching Earth Science Education

- **Provide the Nation with life-long learning opportunities about climate change research, weather prediction, and solid Earth and natural hazards**
- **Partner with educators to build human capacity to create effective decision support resources**


***Improving public awareness, appreciation and understanding of Earth system science and encouraging pursuit of careers in science and technology using NASA-unique content and resources***



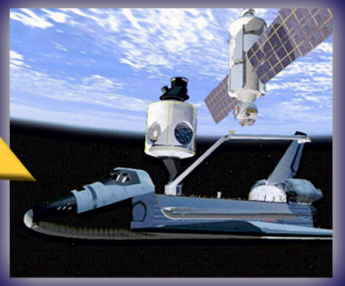
# Virtual Earth: Science and Solutions




Models


Education


Decision Support



Measurements



# Learning through Telepresence

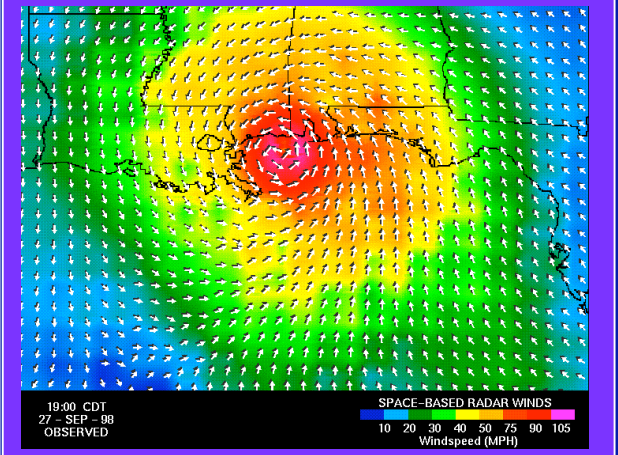
## 4-D Internet Visualization

Access to continuously updated databases of Earth science data with capability to view time series

## Context-Sensitive Education Modules

Access to continuously updated education modules on Earth science, remote sensing technologies, missions, models, and decision support tools

## Context-Sensitive Models & Decision Support Tools




Access to continuously updated models and decision support tools for learning how to run scenarios



# Learning through Telepresence

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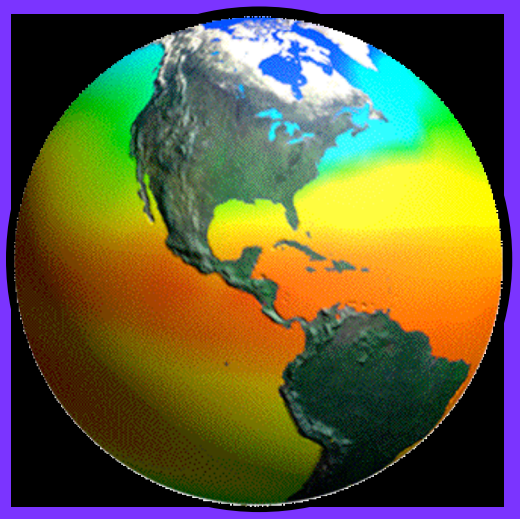

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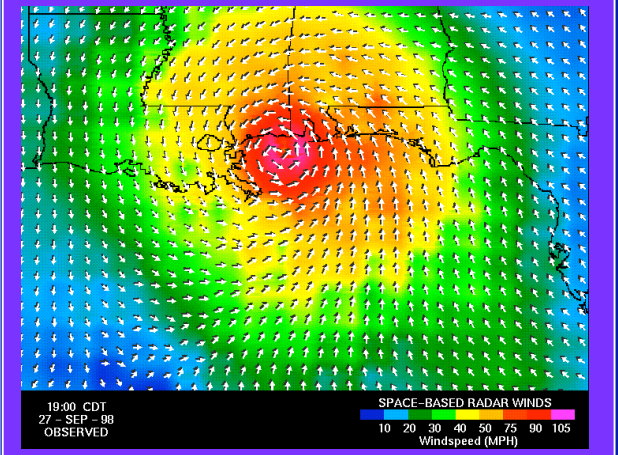


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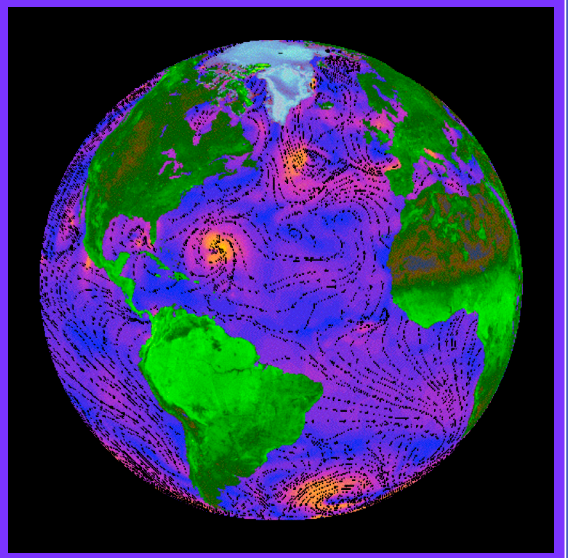

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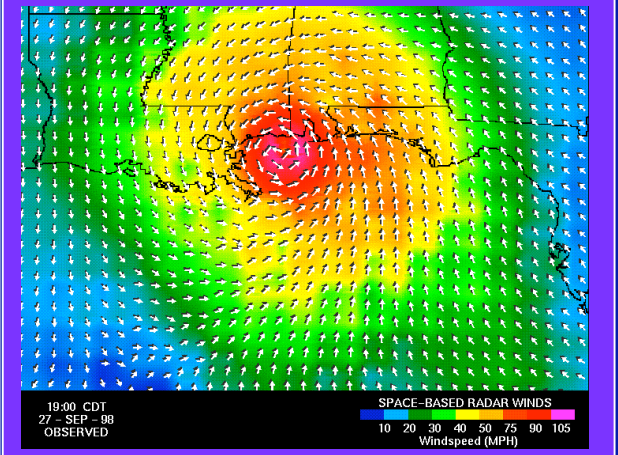


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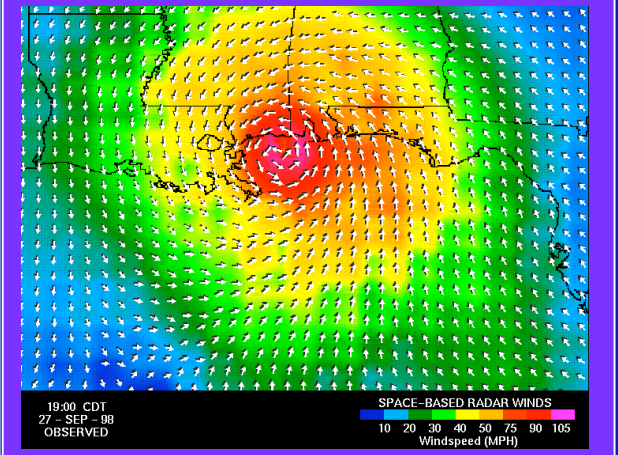


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# Learning through Telepresence

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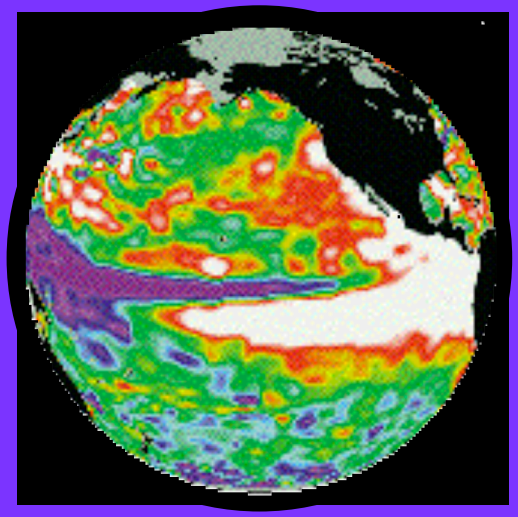

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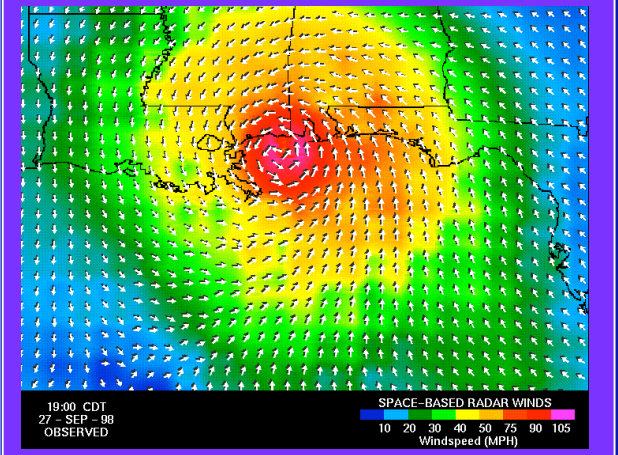


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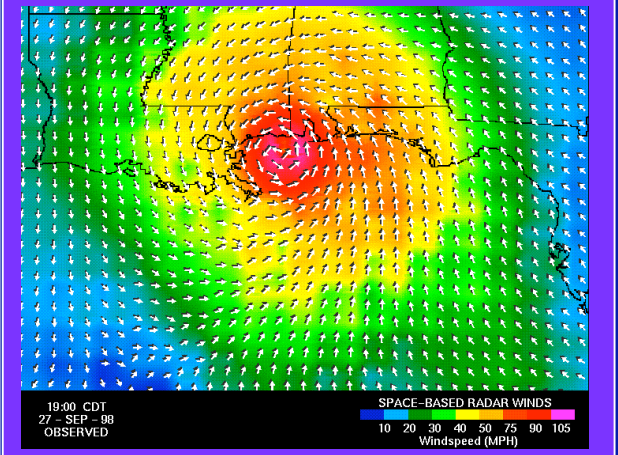


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